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Evaluation Board for the Integer-N PLL Frequency Synthesizer

FEATURES

Self-contained board for generating RF frequencies
Contains ADF4108 8 GHz frequency synthesizer IC
Accompanying software allows complete control of synthesizer functions from a PC

EVALUATION KIT CONTENTS

EV-ADF4108EB1Z board
CD that includes:
- Self-installing software that allows users to control the board and exercise all functions of the device
- Electronic version of the ADF4108 data sheet
- Electronic version of the UG-160 user guide

ADDITIONAL EQUIPMENT

PC running Windows XP or more recent version
Spectrum analyzer
Oscilloscope (optional)
Power supplies of 5.5 V and 15 V

DOCUMENTS NEEDED

ADF4108 data sheet

REQUIRED SOFTWARE

Analog Devices Int-N software (Version 7 or higher)
ADIsimPLL

GENERAL DESCRIPTION

This board is designed, to let the user evaluate the performance of the ADF4108 frequency synthesizer for phase-locked loops (PLLs). Figure 1 shows the board, which contains the ADF4108 synthesizer, an SMA connector for the reference input, power supplies, a USB interface, and RF outputs. There is also an active loop filter and a VCO on board. The board has the option to use an alternate loop filter and VCO by connecting to the SMA connectors, VTUNE, and CPOUT. The evaluation kit contains software that is compatible with Windows® XP and later versions to allow easy programming of the synthesizer.

The USB interface allows software programming of the ADF4108 device. A USB cable is included with the board to allow software programmability.

EVALUATION BOARD

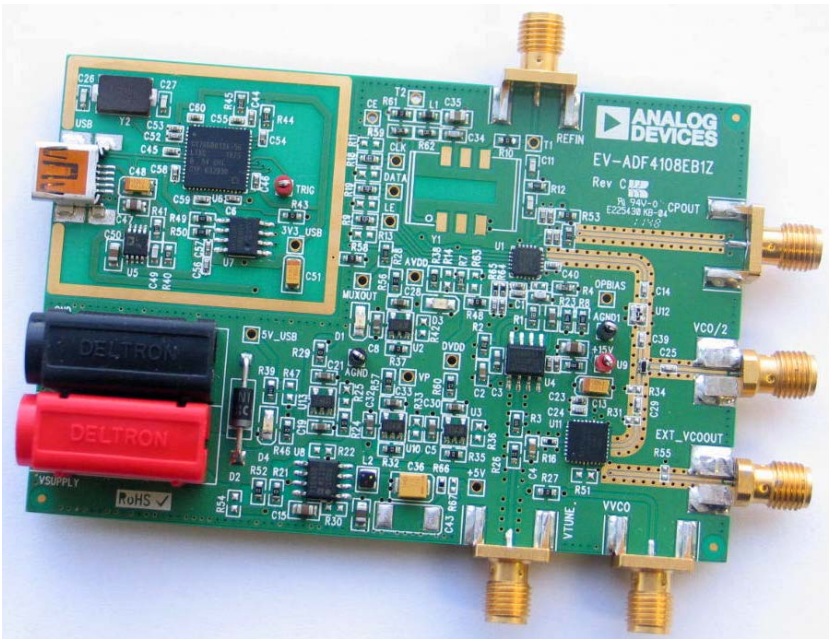

Figure 1. EV-ADF4108EB1Z

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REVISION HISTORY

3/12—Rev. 0 to Rev. A

Changes to Features Section and General Description Section ... 1
Added Evaluation Kit Contents Section, Additional Equipment Section, Documents Needed Section, Required Software Section, and Evaluation Board Section; Deleted Block Diagram Section; Replaced Figure 1 ... 1
Added Quick Start Guide Section ... 3
Deleted Hardware Description Section and Figure 3, Renumbered Sequentially ... 3
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Replaced Figure 2; Added Input Signals Section, Output Signals Section, and Default Operations Section ... 4
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Added Evaluation Board Setup Procedure Section Software Installation Section, and Figure 3 to Figure 5 ... 5
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7/11—Revision 0: Initial Version

QUICK START GUIDE

Use the following steps to evaluate the ADF4108 device:

1. Install the Int-N software.
2. Follow the hardware driver installation procedure.
3. Connect the power supplies to the EV-ADF4108EB1Z:
    a. The 5.5 V power supply to the on-board banana connectors.
    b. The 15 V power supply to test points labeled +15 V and AGND1.
4. Connect the USB cable to the PC and to the EV-ADF4108EB1Z.
5. Run the Int-N software.
6. Select the ADF4108 device and the USB board in the **Select Device and Connection** tab of the software front panel window.
7. Ensure that the message "board connected" appears on front panel.
8. Connect the reference frequency to REFIN (SMA).
9. Click the **Main Controls** tab to input RF Settings and Settings.
10. Note that the **Phase Detector Polarity** drop-down list in the Settings section should be set to **Negative** to suit the active loop filter in inverting mode.
11. Update all registers.
12. Connect the output to a signal source analyzer. The board offers two outputs.
    a. VCO/2 via SMA labeled VCO/2
    b. VCO via SMA labeled EXT_VCOOUT
13. Measure the results.

EVALUATION BOARD HARDWARE

The evaluation board comes with a mini-USB cable to connect to the USB port of a PC. The evaluation board silkscreen is shown in Figure 2. The EV-ADF4108EB1Z schematics are shown in Figure 21, Figure 22, Figure 23, and Figure 24.

POWER SUPPLIES

The board is powered via two external supplies, 5.5 V and 15 V, and connected as described in the Quick Start Guide Section on page 3.

INPUT SIGNALS

The necessary reference input can be from an external generator. A low noise, high slew rate reference source is best for achieving the stated performance of the ADF4108. This reference source is connected to the SMA connector REFIN. A second option is to solder a footprint-compatible TCXO to Footprint Y1.

OUTPUT SIGNALS

The VCO output is available at EXT_VCOOUT through a standard SMA connector. A divide by 2 option is also available at the SMA connector VCO/2. To use an alternate loop filter and VCO, the charge pump output CPOUT and the VCO tune voltage VTUNE are available as outputs via standard SMA connectors.

DEFAULT OPERATION

All components necessary for LO generation can be inserted on the board. The board is shipped with the ADF4108 synthesizer, an active loop filter, and the VCO.

An active loop filter using standard feedback is inserted between the charge pump output and the VCO input. The design parameters for the loop filter are for a center frequency of 7500 MHz, a PFD frequency of 2500 kHz, and an active loop filter bandwidth of 17 kHz. To design a filter for different frequency setups, use the ADIsimPLL simulation software to generate filter component values and evaluate results.

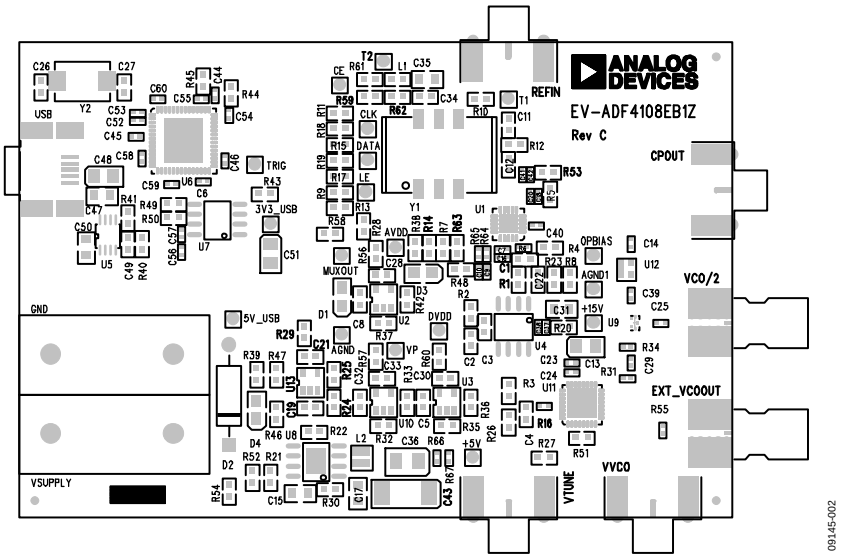


Figure 2. Evaluation Board Silkscreen

EVALUATION BOARD SETUP PROCEDURE

SOFTWARE INSTALLATION

Use the following steps to install the USB drivers and Int-N software.

1. Install the Analog Devices Int-N software by double-clicking **ADI_Int-N_Setup.msi**.
   If you are using Windows XP, follow the instructions in the Windows XP Software Installation Guide section (see Figure 3 to Figure 7).

   If you are using Windows Vista or Windows 7, follow the instructions in the Windows Vista and Windows 7 Software Installation Guide section (see Figure 8 to Figure 12).

   Note that the software requires Microsoft Windows Installer and Microsoft .NET Framework 3.5 (or higher). The installer connects to the Internet and downloads Microsoft .NET Framework automatically. Alternatively, before running the **ADI_Int-N_Setup.msi**, both the installer and .NET Framework can be installed from the CD provided.
2. Plug the USB cable into the USB connector on the evaluation board. If you are using Windows XP, follow the steps in the Windows XP Driver Installation Guide section (see Figure 13 to Figure 16).

   On Windows Vista or Windows 7, the drivers install automatically.

Windows XP Software Installation Guide

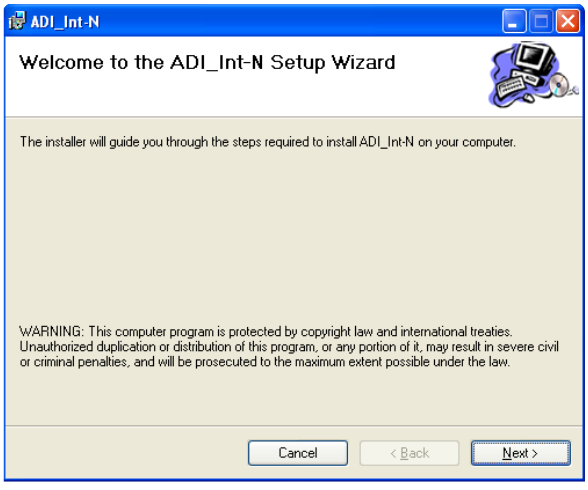

ADI_Int-N
Welcome to the ADI_Int-N Setup Wizard
The installer will guide you through the steps required to install ADI_Int-N on your computer.
WARNING: This computer program is protected by copyright law and international treaties. Unauthorized duplication or distribution of this program, or any portion of it, may result in severe civil or criminal penalties, and will be prosecuted to the maximum extent possible under the law.
Cancel
< Back
Next >
09145-003

Figure 3. Windows XP Int-N Software Installation, Setup Wizard

1. Click **Next**.

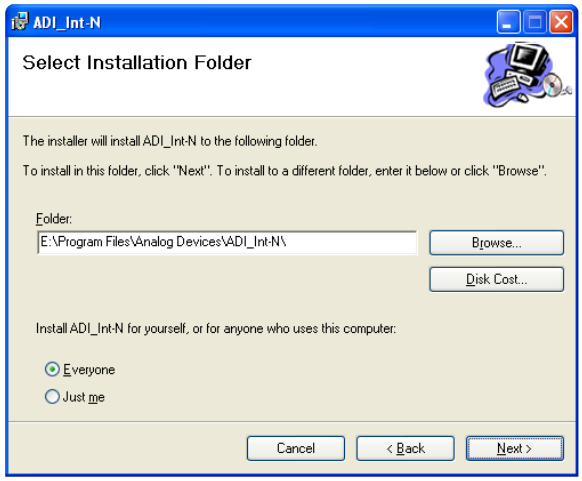

ADI_Int-N
Select Installation Folder
The installer will install ADI_Int-N to the following folder.
To install in this folder, click "Next". To install to a different folder, enter it below or click "Browse".
Folder:
E:\Program Files\Analog Devices\ADI_Int-N\
Browse...
Disk Cost...
Install ADI_Int-N for yourself, or for anyone who uses this computer:
Everyone
Just me
Cancel
< Back
Next >
09145-004

Figure 4. Windows XP Int-N Software Installation, Select Installation Folder

2. Choose an installation directory, and then click **Next**.

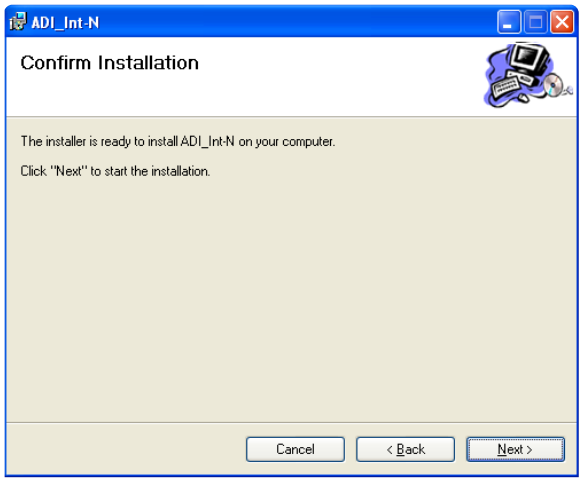


Figure 5. Windows XP Int-N Software Installation, Confirm Installation

3. Click **Next**.

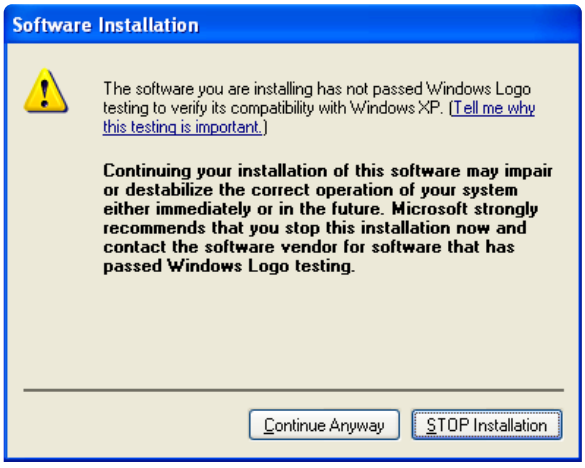

Software Installation
The software you are installing has not passed Windows Logo testing to verify its compatibility with Windows XP. (Tell me why this testing is important.)
Continuing your installation of this software may impair or destabilize the correct operation of your system either immediately or in the future. Microsoft strongly recommends that you stop this installation now and contact the software vendor for software that has passed Windows Logo testing.
Continue Anyway
STOP Installation
09145-006

Figure 6. Windows XP Int-N Software Installation, Logo Testing

4. Click **Continue Anyway**.

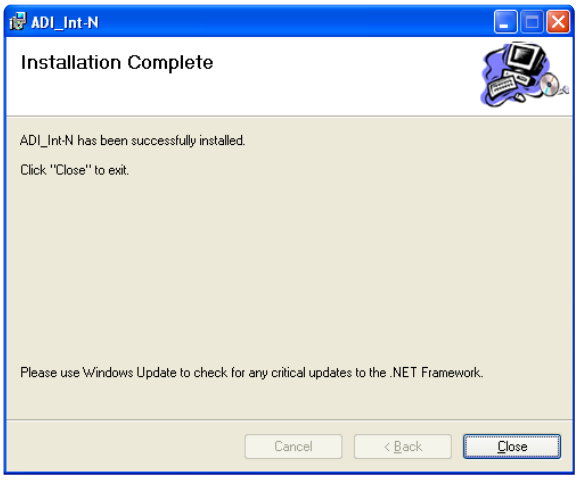
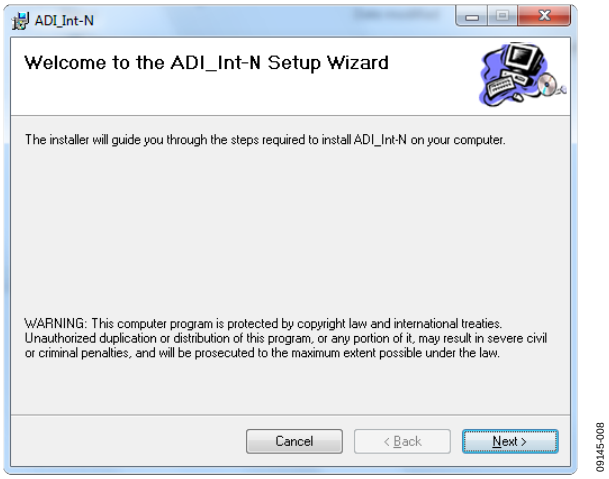


Figure 7. Windows XP Int-N Software Installation, Installation Complete

3. Click **Close**.

Windows Vista and Windows 7 Software Installation Guide


ADI_Int-N
Welcome to the ADI_Int-N Setup Wizard
The installer will guide you through the steps required to install ADI_Int-N on your computer.
WARNING: This computer program is protected by copyright law and international treaties. Unauthorized duplication or distribution of this program, or any portion of it, may result in severe civil or criminal penalties, and will be prosecuted to the maximum extent possible under the law.
Cancel
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Next >
09145-008

Figure 8. Windows Vista/7 Int-N Software Installation, Setup Wizard

1. Click **Next**.

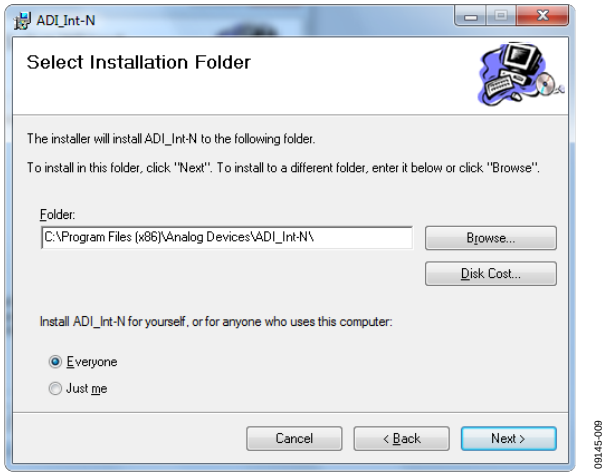

ADI_Int-N
Select Installation Folder
The installer will install ADI_Int-N to the following folder.
To install in this folder, click "Next". To install to a different folder, enter it below or click "Browse".
Folder:
C:\Program Files (x86)\Analog Devices\ADI_Int-N\
Browse...
Disk Cost...
Install ADI_Int-N for yourself, or for anyone who uses this computer:
Everyone
Just me
Cancel
< Back
Next >
09145-009

Figure 9. Windows Vista/7 Int-N Software Installation, Select Installation Folder

2. Choose an installation directory, and then click **Next**.

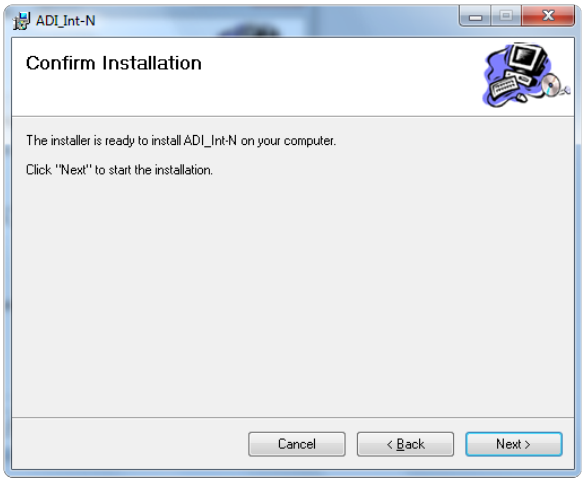


Figure 10. Windows Vista/7 Int-N Software Installation, Confirm Installation

3. Click **Next**.

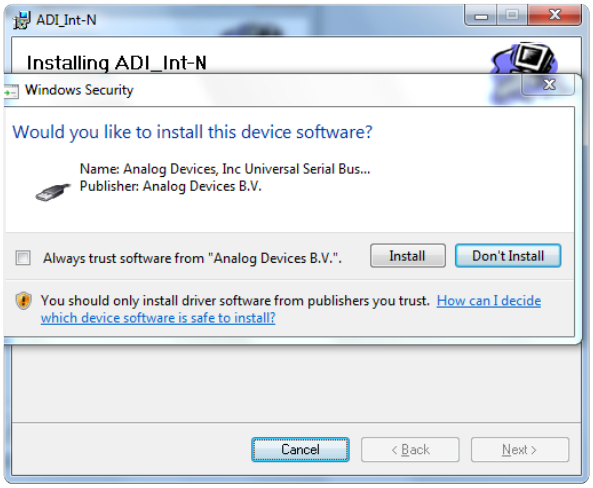

ADI_Int-N
Installing ADI_Int-N
Windows Security
Would you like to install this device software?
Name: Analog Devices, Inc Universal Serial Bus...
Publisher: Analog Devices B.V.
Always trust software from "Analog Devices B.V.".
Install
Don't Install
You should only install driver software from publishers you trust. How can I decide which device software is safe to install?
Cancel
< Back
Next >
09145-011

Figure 11. Windows Vista/7 Int-N Software Installation, Start Installation

4. Click **Install**.

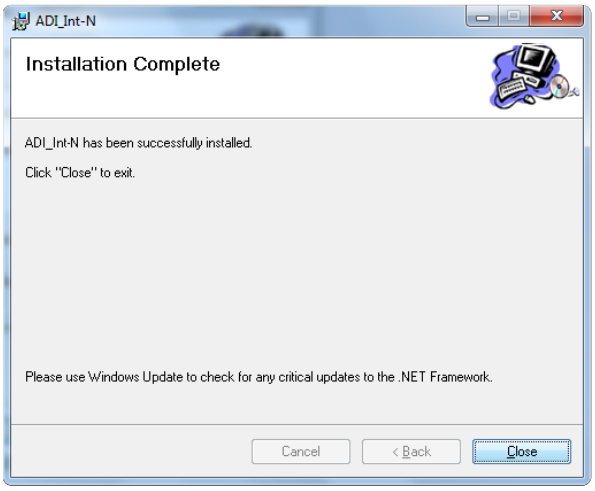


Figure 12. Windows Vista/7 Int-N Software Installation, Installation Complete

5. Click **Close**.

Windows XP Driver Installation Guide

Found New Hardware Wizard
Welcome to the Found New Hardware Wizard
Windows will search for current and updated software by looking on your computer, on the hardware installation CD, or on the Windows Update Web site (with your permission).
Read our privacy policy
Can Windows connect to Windows Update to search for software?
Yes, this time only
Yes, now and every time I connect a device
No, not this time
Click Next to continue.
< Back
Next >
Cancel
09145-013

Figure 13. Windows XP USB Adapter Board Driver Installation, Found New Hardware Wizard

1. Select the **Yes, this time only** option, and then click **Next**.

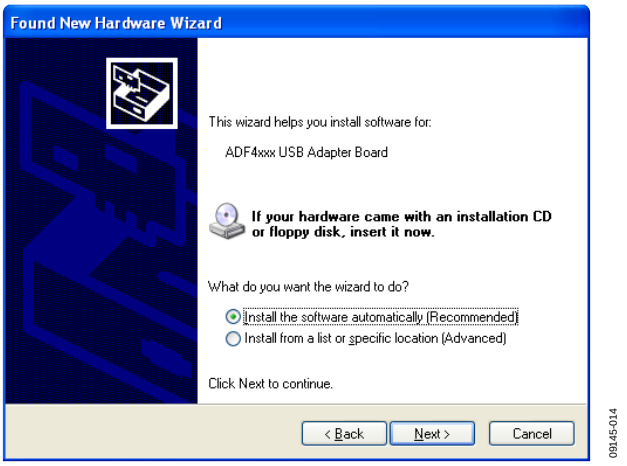

Found New Hardware Wizard
This wizard helps you install software for:
ADF4xxx USB Adapter Board
If your hardware came with an installation CD or floppy disk, insert it now.
What do you want the wizard to do?
Install the software automatically (Recommended)
Install from a list or specific location (Advanced)
Click Next to continue.
< Back
Next >
Cancel
09145-014

Figure 14. Windows XP USB Adapter Board Driver Installation, Installation Options

2. Click **Next**.

Note that the window in Figure 14 may list **Analog Devices RFG.L Eval Board** instead of **ADF4xxx USB Adapter Board**.

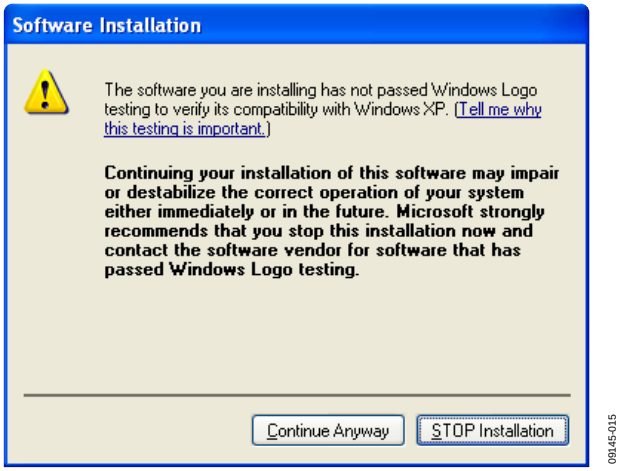

Software Installation
The software you are installing has not passed Windows Logo testing to verify its compatibility with Windows XP. (Tell me why this testing is important.)
Continuing your installation of this software may impair or destabilize the correct operation of your system either immediately or in the future. Microsoft strongly recommends that you stop this installation now and contact the software vendor for software that has passed Windows Logo testing.
Continue Anyway
STOP Installation
09145-015

Figure 15. Windows XP USB Adapter Board Driver Installation, Logo Testing

3. Click **Continue Anyway**.

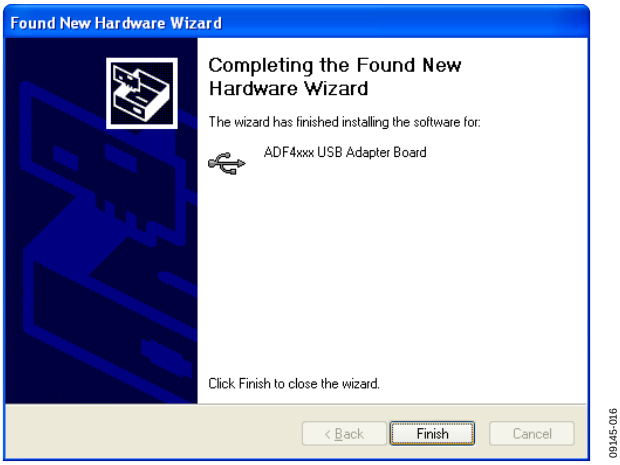


Figure 16. Windows XP USB Adapter Board Driver Installation, Complete Installation

4. Click **Finish**.

EVALUATION BOARD SOFTWARE

The control software for the EV-ADF4108EB1Z accompanies the EV-ADF4108EB1Z on a CD. To install the software, see the Software Installation section.

To run the software, click the **Int-N v7** file on the desktop or in the Start menu.

On the **Select Device and Connection** tab, choose your device and your connection method, and then click **Connect.**

Confirm that "Analog Devices RFG.L Eval Board connected" is displayed at the bottom left of the window (see Figure 17). Otherwise, the software has no connection to the evaluation board.

Note that, when connecting the board, it takes about 5 to 10 seconds for the status label to change.

Under the **File** menu, the current settings can be saved to, and loaded from, a text file.

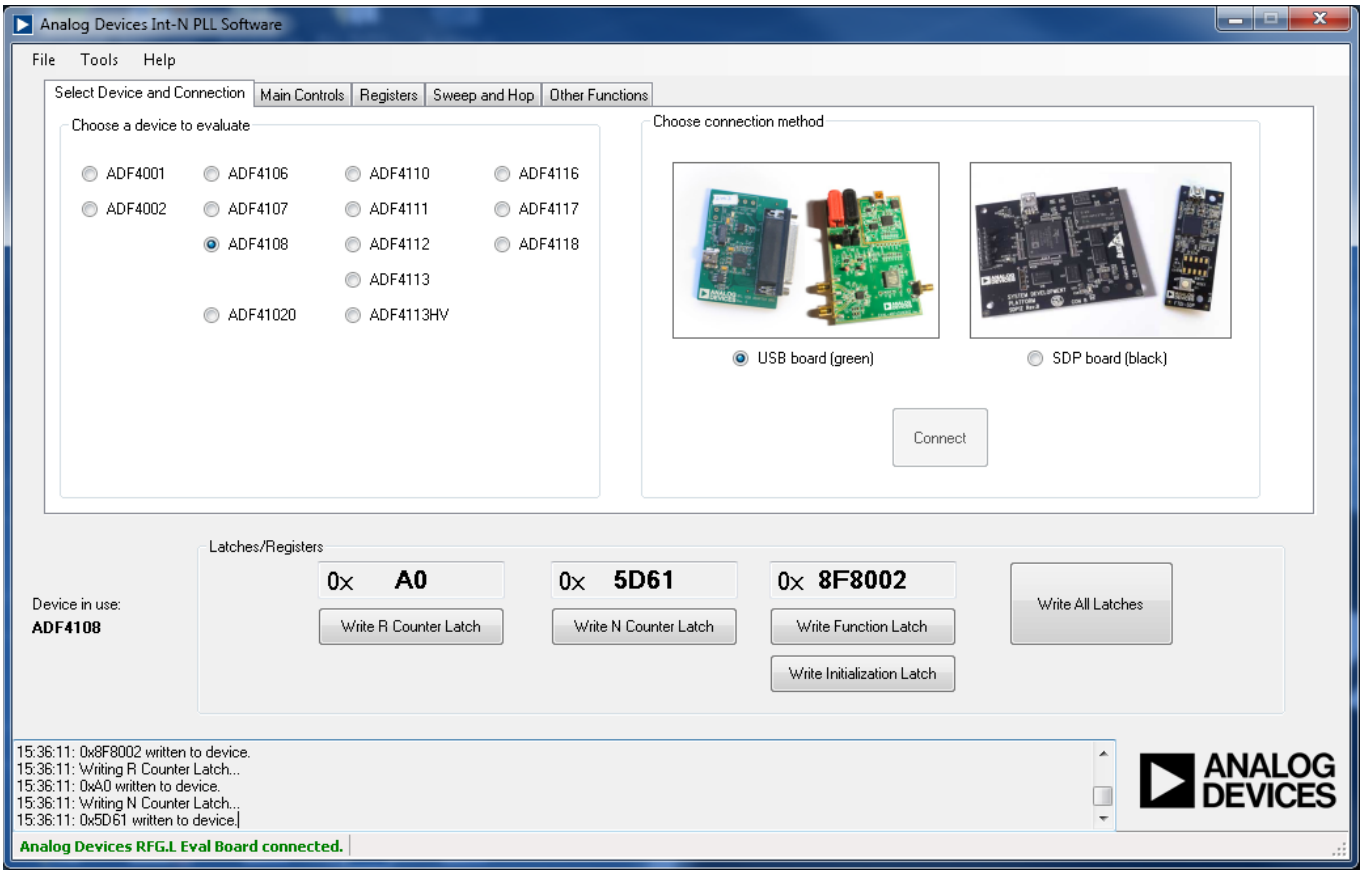


Figure 17. Software Front Panel Display—Select Device and Connection

The **Main Controls** tab controls the PLL settings (see Figure 18).

Use the RF Settings section to control the output frequency. You can type the desired output frequency in the **RF VCO Output Frequency** text box (in MHz).

Use the **Reference Frequency** text box to set the correct reference frequency and the reference frequency divider. The default reference on the software window is at 100 MHz.

The Settings section lets you select general options available for the PLL, including the charge pump current settings and phase detector polarity. The EV-ADF4108EB1Z uses a charge pump setting of 5 mA and a negative Phase Detector Polarity.

In the **Registers** tab, you can manually input the desired value to be written to the registers.

In the **Sweep and Hop** tab, you can make the device sweep a range of frequencies or hop between two set frequencies.

In the **Latches/Registers** section at the bottom of the window, the values to be written to each register are displayed. If the background on the text box is green, the value displayed is different from the value actually on the device. Click **Write R Counter Latch** or **Write N Counter Latch** to write that value to the device. To update all Latches in the correct order, click **Write all Latches.**

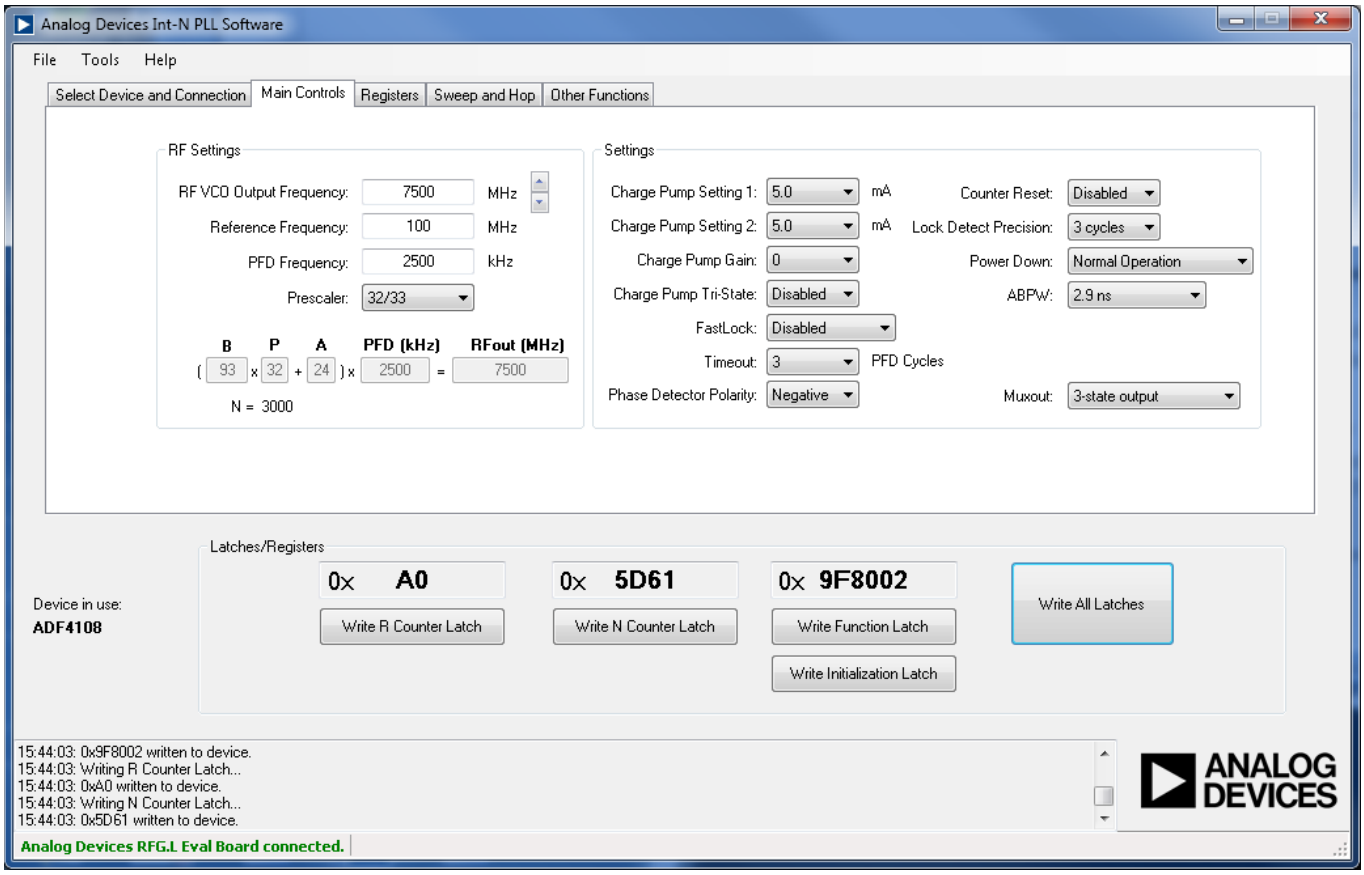


Figure 18. Software Front Panel Display—Main Controls

EVALUATION AND TEST

To evaluate and test the performance of the ADF4108, use the following steps:

1. Install the Analog Devices Int-N software
2. Use ADIsimPLL to generate the loop filter component values if a different loop filter is required.
3. Solder new filter components specified by ADIsimPLL.
4. Install the USB software drivers. Connect the evaluation board to a PC using the supplied USB cable. Follow the hardware driver installation procedure that appears.
5. Connect the USB connector to the EV-ADF4108EB1Z.
6. Connect a Reference signal to REFIN.
7. Connect a spectrum analyzer to EXT_VCOOUT OR VCO/2.
8. Run the Int-N software.
9. Select the USB board and the ADF4108 device in the **Select Device and Connection** tab of the software front panel window.
10. On the Main Controls tab, set the VCO center frequency (Figure 19 uses a 7.5 GHz VCO). Set the PFD frequency as specified in ADIsimPLL, and program the Reference frequency to match Reference connected to SMA Connector REFIN (or the TCXO). See Figure 20 for the suggested setup.
11. Measure the output spectrum. Figure 19 shows a 7.5 GHz output.

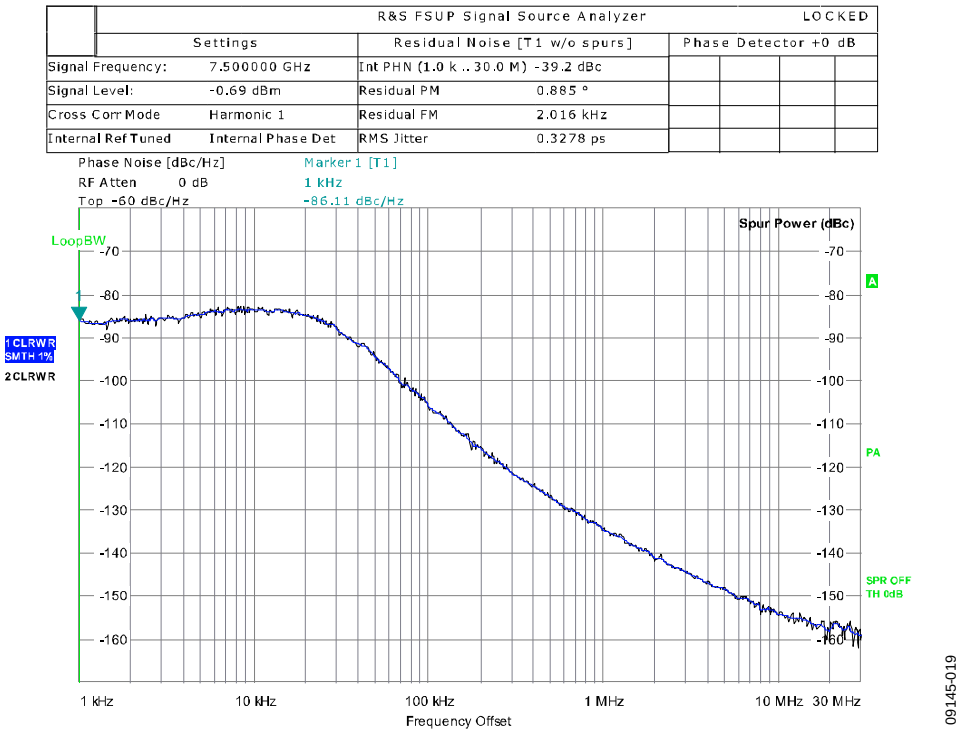


Figure 19. Spectrum Analyzer Display

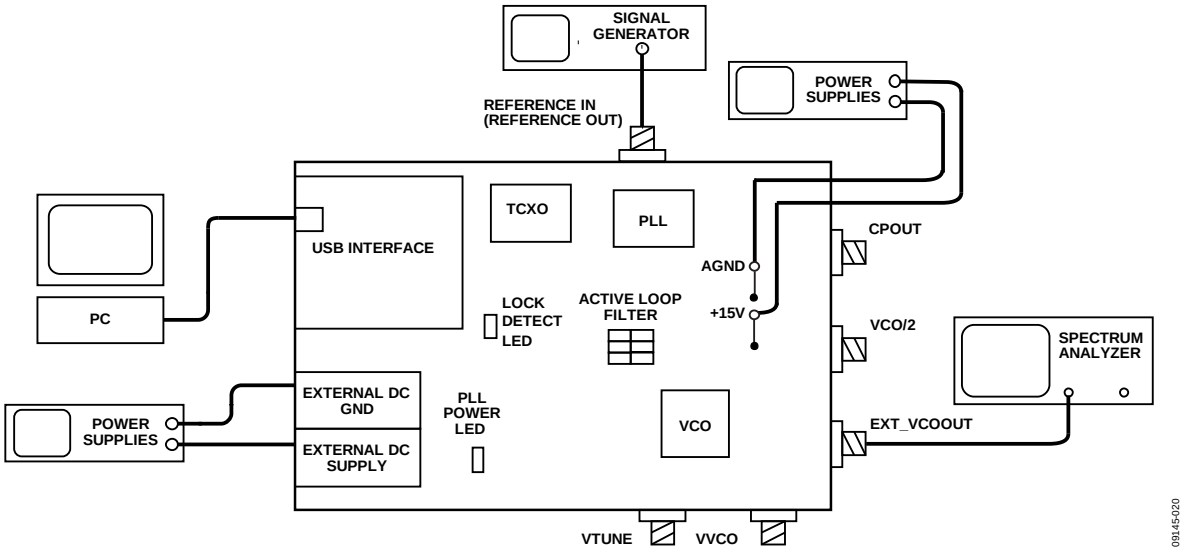
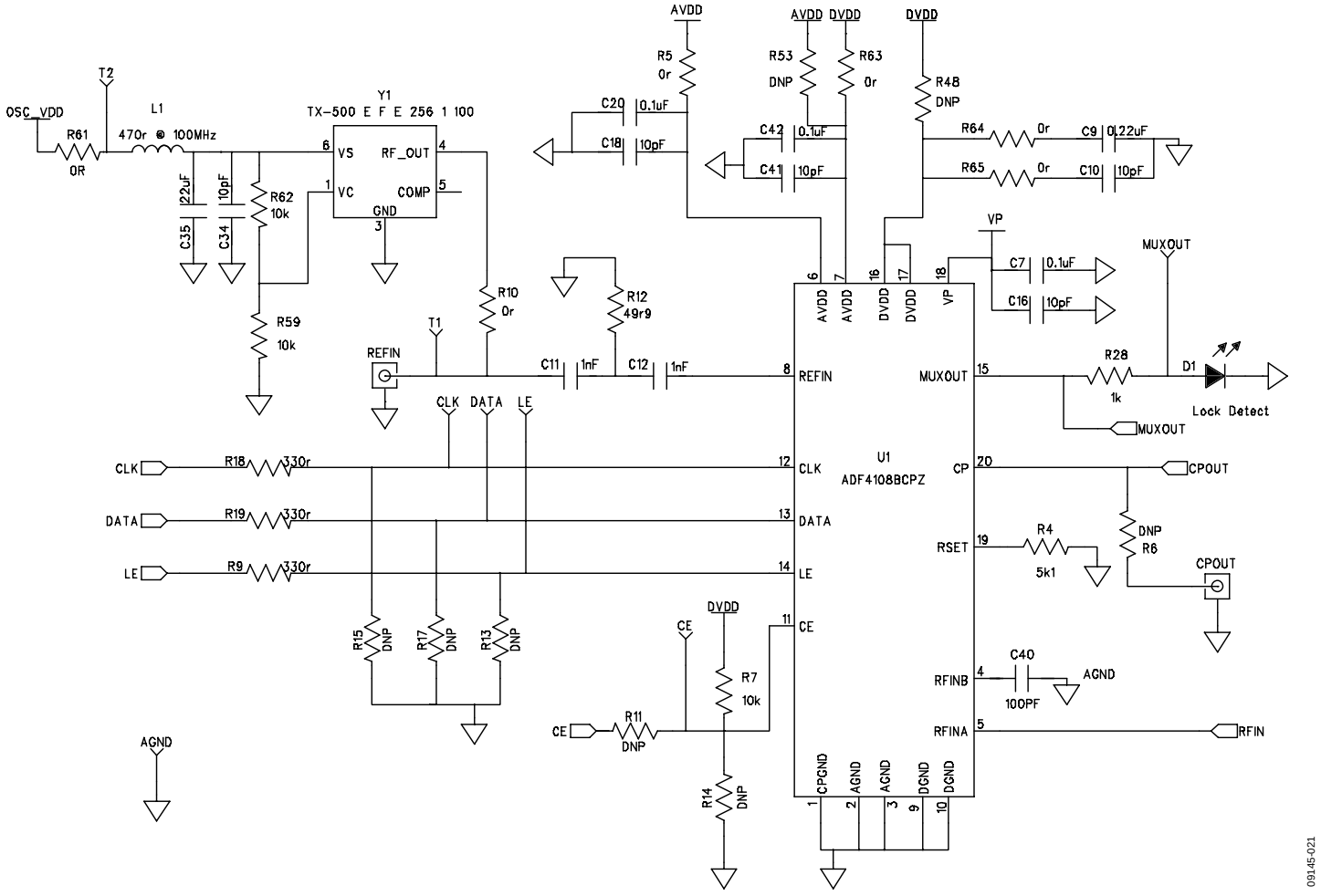


Figure 20. Typical Evaluation Setup

EVALUATION BOARD SCHEMATICS AND ARTWORK



09145-021

Figure 21. Evaluation Board Schematic (Page 1)

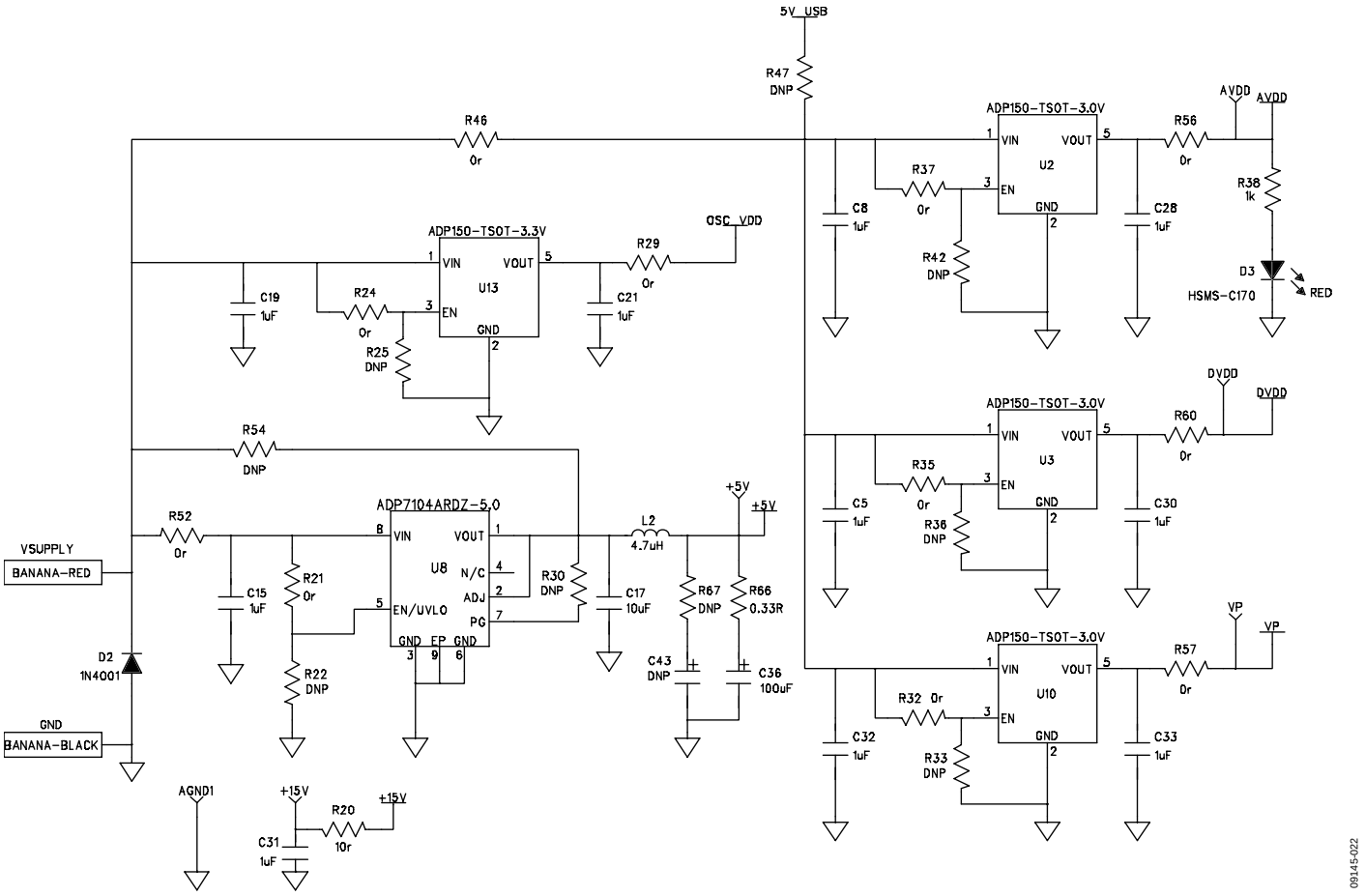


Figure 22. Evaluation Board Schematic (Page 2)

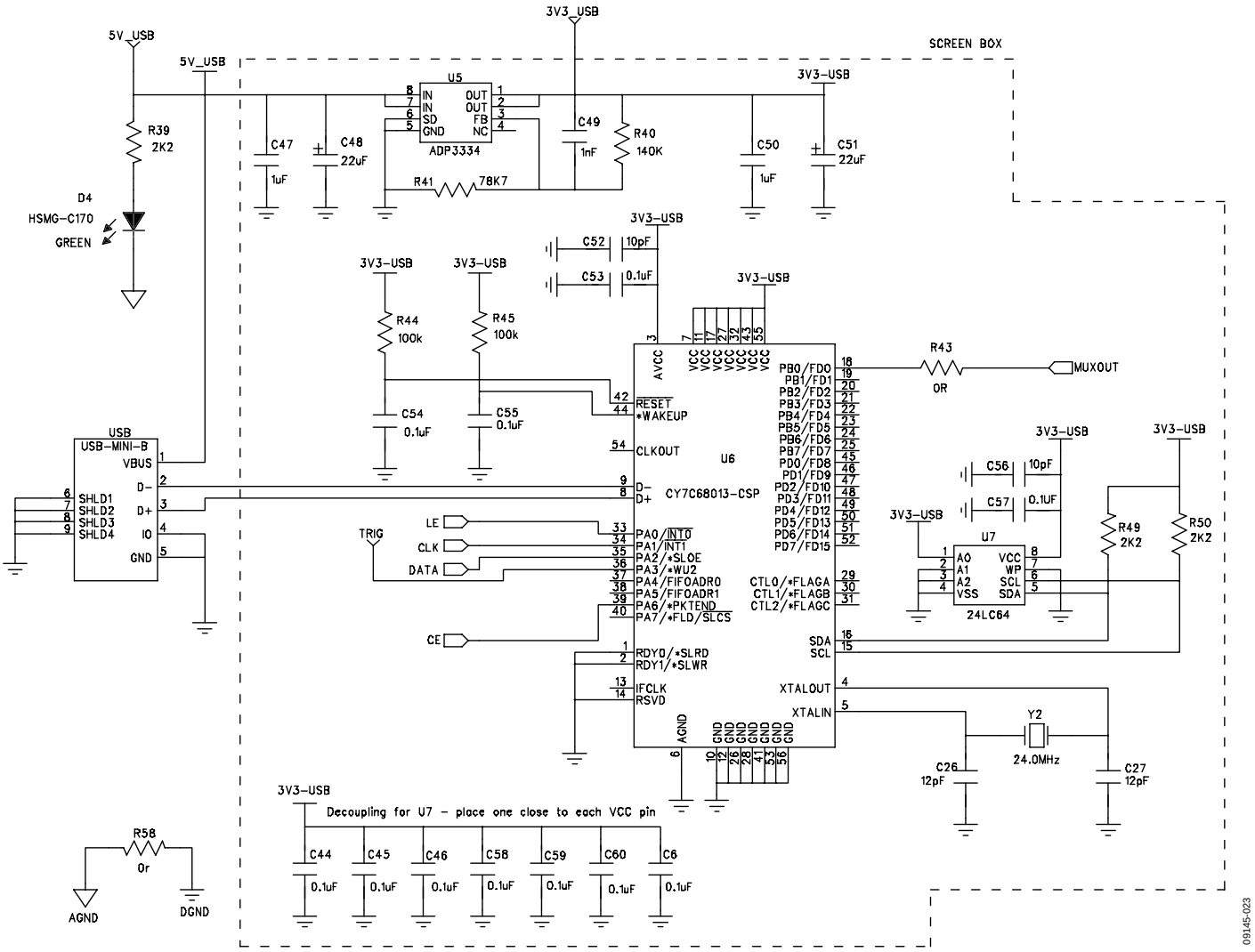


Figure 23. Evaluation Board Schematic (Page 3)

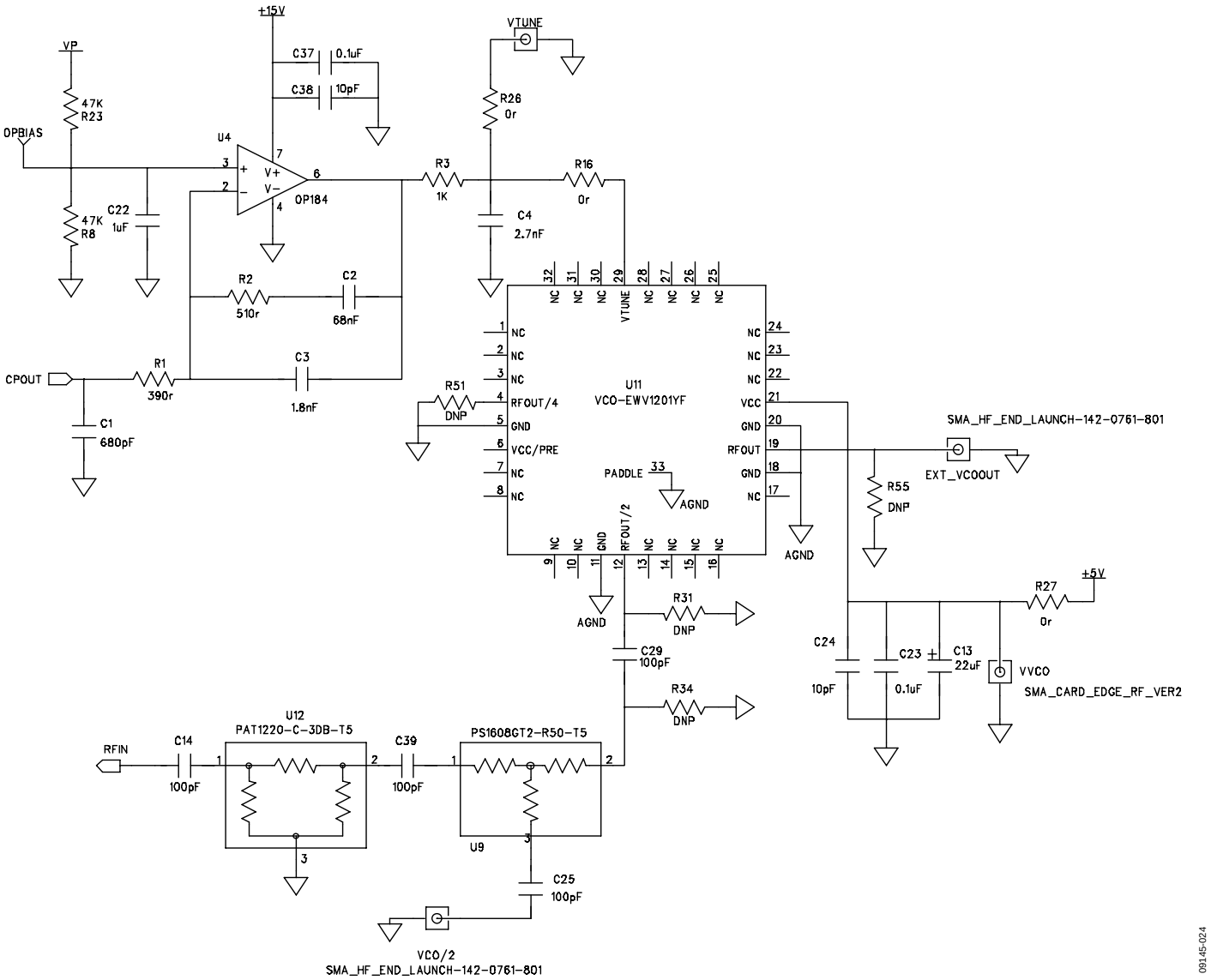


Figure 24. Evaluation Board Schematic (Page 4)

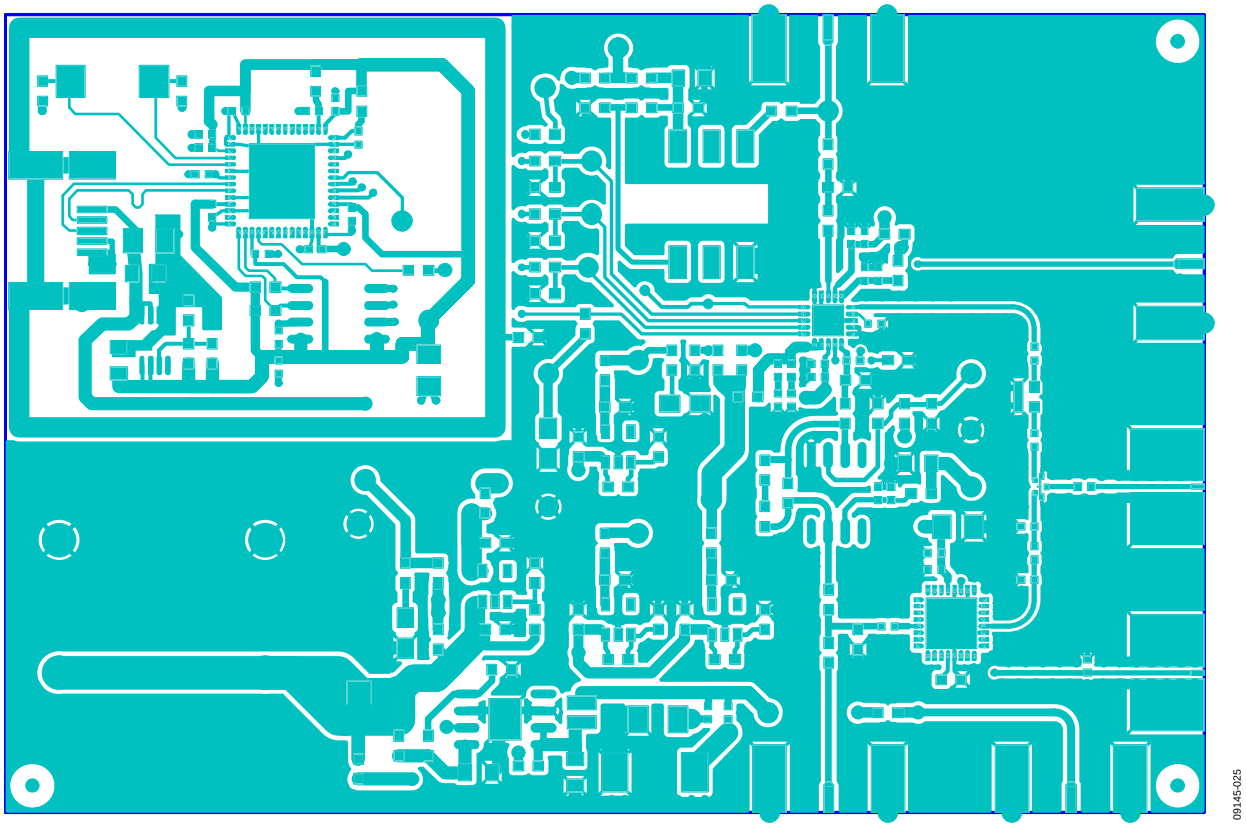


Figure 25. Layer 1 (Component Side)

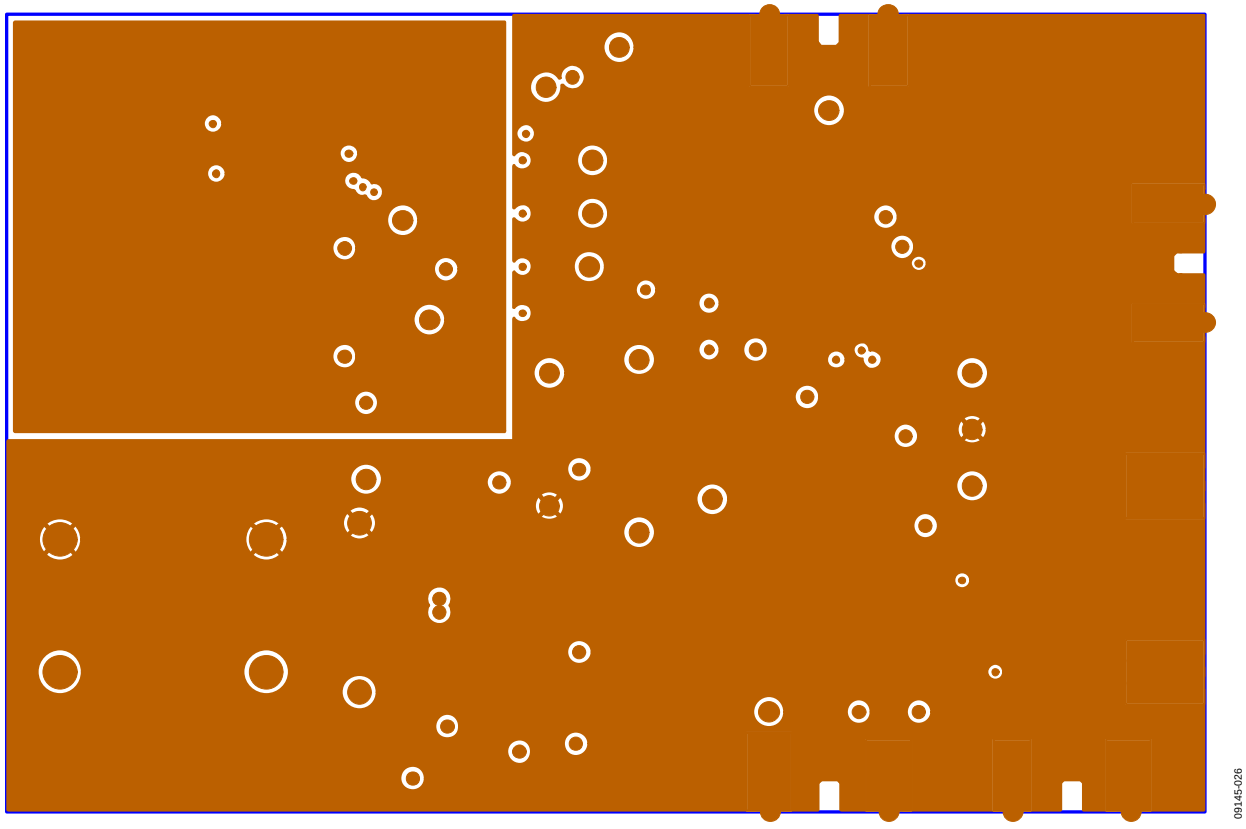


Figure 26. Layer 2 (Ground Plane)

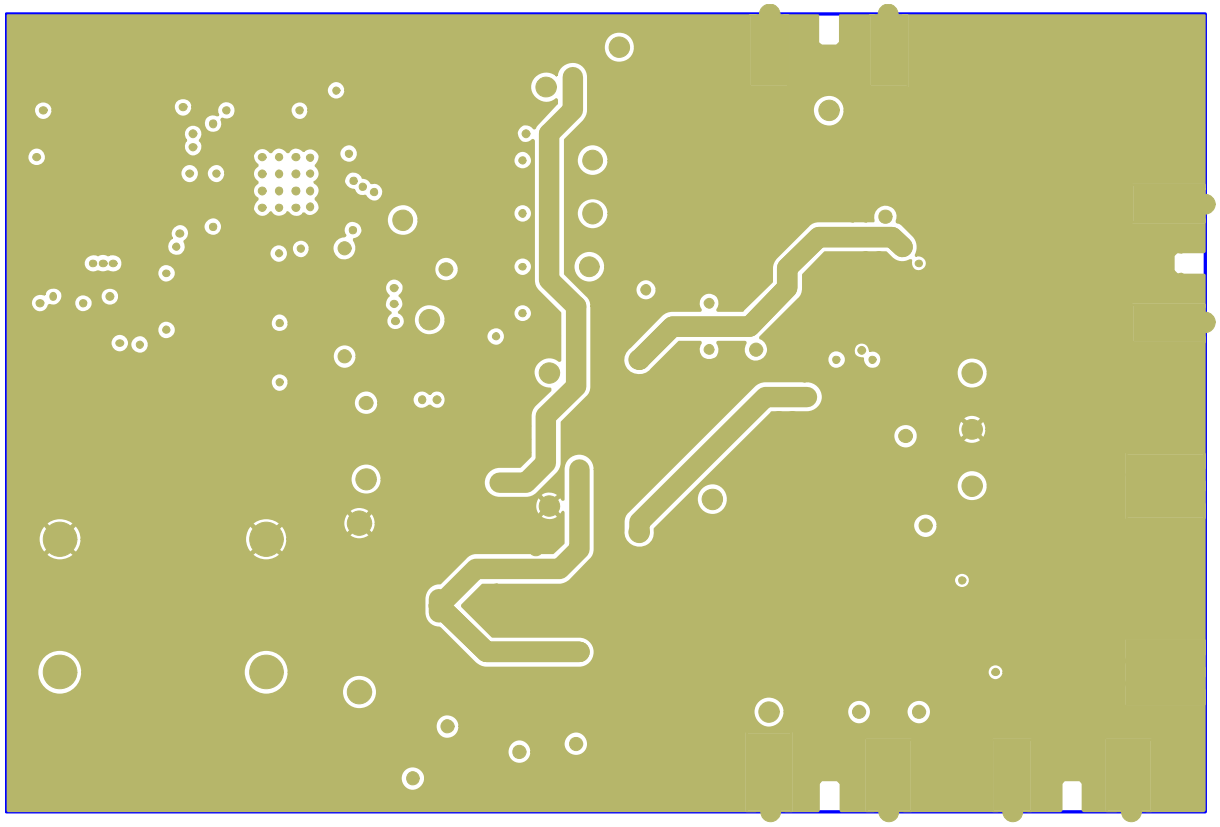


Figure 27. Layer 3 (Power/Ground Plane)

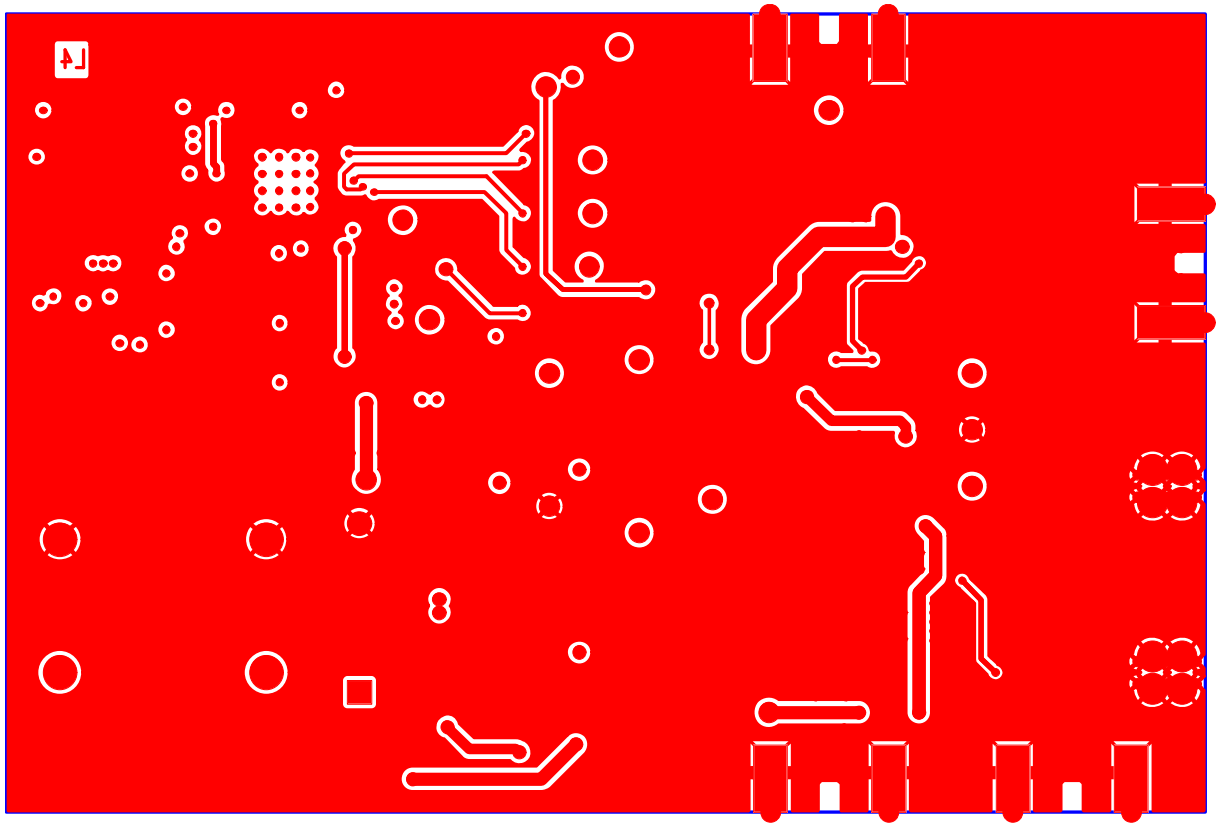


Figure 28. Layer 4 (Solder Side)

ORDERING INFORMATION

BILL OF MATERIALS

Table 1.

Reference Designator	Part Description
+5V, +15V, 3V3_USB,[1] 5V_USB,[1] AVDD,[1] CE,[1] CLK,[1] DATA,[1] DVDD,[1] LE,[1] MUXOUT,[1] OPBIAS,[1] T1,[1] T2,[1] RIG, VP[1]	Red test point
AGND, AGND1	Black test point
C1	Capacitor, 0603, 50 V, 680 pF, COG/NPO
C2	Capacitor, 0603, X7R, 50 V, 68 nF
C3	Capacitor, 0603, X7R, 50 V, 1.8 nF
C4	Capacitor, 0603, X7R, 50 V, 2.7 nF
C5, C8, C19, C21, C22, C28, C30, C32, C33	Capacitor, 0603, 1 µF, 10 V, X5R
C6, C7, C20, C42, C44, C45, C46, C53, C54, C55, C57, C58, C59, C60	X7R ceramic capacitor, 0402,16 V, 0.1 µF
C9	X5R ceramic capacitor, 0402, 6.3 V, 0.22 µF
C10, C16, C18, C24, C38, C41, C52, C56	NP0 ceramic capacitor, 0402, 50 V, 10 pF
C11, C12, C49	NP0 ceramic capacitor, 0603, 50 V, 1 nF
C13, C48, C51	Tantalum capacitor (TAJ-A Case), RTAJ_A, 6.3 V, 22 µF
C14, C25, C29, C39	COG ceramic capacitor, 0402, 50 V, 100 pF
C15, C31, C47, C50	Capacitor, X5R, 0805, 1.0 µF, 50 V
C17	Capacitor, X5R 0805, 10 V, 10 µF, 10%
C23, C37	X5R ceramic capacitor, 0402, 25 V, 0.1 µF
C26, C27	NPO SMD ceramic capacitor, 0603, 50 V, 10 pF
C34	Multilayer ceramic capacitor, 0603, 10 pF
C35	X5R ceramic capacitor, 0805, 6.3 V, 22 µF
C36	Capacitor, CASE B, 100 µF, 6.3 V, RTAJ_B
C40	Capacitor, 0402, 100 pF, 50 V, NP0
C43[1]	Capacitor, RTAJ_D
CPOUT, REFIN, VTUNE, VVCO	Conn jack end launch PC gold SMA
D1, D4	LED, green
D2	Diode, standard, 1 A, 50 V
D3	LED, red
EXT_VCOOUT, VCO/2	High frequency SMA end launch connector—142-0761-801
GND	Black 4mm banana socket
L1	Ferrite bead, 470 Ω @ 100MHz
L2	Inductor, SMT Power EPL2014 Series, 4.7 µH
R1	Resistor, 0603, 390 Ω
R2	Resistor, 0603, 510 Ω
R3, R28, R38	Resistor, 0603, 1 kΩ
R4	Resistor, 0603, 5.1 kΩ
R5, R10, R21, R24, R26, R27, R29, R32, R35, R37, R43, R46, R48, R52, R53, R56, R57, R58, R60, R61	Resistor, 0603, 0 Ω
R6,[1] R31,[1] R34,[1] R55,[1] R67[1]	Resistor, 0402
R7, R59, R62	Resistor, 0603, 10 kΩ
R8, R23	Resistor, 0603, 47 kΩ
R9, R18, R19	Resistor, 0603, 330 Ω
R11,[1] R13,[1] R14,[1] R15,[1] R17,[1] R22,[1] R25,[1] R30,[1] R33,[1] R36,[1] R42,[1] R47,[1] R51,[1] R54,[1] R63[1]	Resistor, 0603

Reference Designator	Part Description
R12	Resistor, 0603, 49.9 Ω
R16, R64, R65,	Resistor, 0402, 0 Ω
R20	Resistor, 0603, 10 Ω
R39 R49, R50,	Resistor, 0603, 2.2 kΩ
R40	Resistor, 0603, 140 kΩ
R41	Resistor, 0603, 78.7 kΩ
R44, R45,	Resistor, 0603, 100 kΩ
R66	Resistor, 0402, 0.33 Ω
U1	ADF4108, PLL frequency synthesizer
U2, U3, U10, U13	ADP150AUJZ-3.0, 3.0 V linear regulator
U4	OP184, single op amp
U5	ADP3334, adjustable LDO regulator
U6	USB microcontroller
U7	64 K, I2C Serial EEPROM
U8	ADP7104ARDZ-5.0, linear regulator
U9	Power divider, 6 dB, 1 W, 0603 SMD
U11	VCO, dual output and divide by 2 prescaler
U12	Attenuator, 3 dB, 50 Ω, 0805 SMD
VSUPPLY	Red 4 mm banana socket
Y1[1]	TX-500 temperature compensated crystal oscillator, 100.0 MHz
Y2	SMD crystal, 24.0 MHz

[1] Do not insert.

RELATED LINKS

ADF4108	Product Page, PLL Frequency Synthesizer
ADP150AUJZ	Product Page, Ultralow Noise, 150 mA CMOS Linear Regulator
OP184	Product Page, Single-Supply Rail-to-Rail Input/Output Operational Amplifier
ADP3334	Product Page, High Accuracy Low I_Q, 500 mA anyCAP® Adjustable Low Dropout Regulator
ADP7104ARDZ	Product Page, 20 V, 500 mA, Low Noise, CMOS LDO

NOTES

I²C refers to a communications protocol originally developed by Philips Semiconductors (now NXP Semiconductors).

EEB Caution

EEB (electrostatic discharge) sensitive device. Charged devices and circuit boards can discharge without detection. Although this product features patented or proprietary protection circuitry, damage may occur on devices subjected to high energy EEB. Therefore, proper EEB precautions should be taken to avoid performance degradation or loss of functionality.

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